

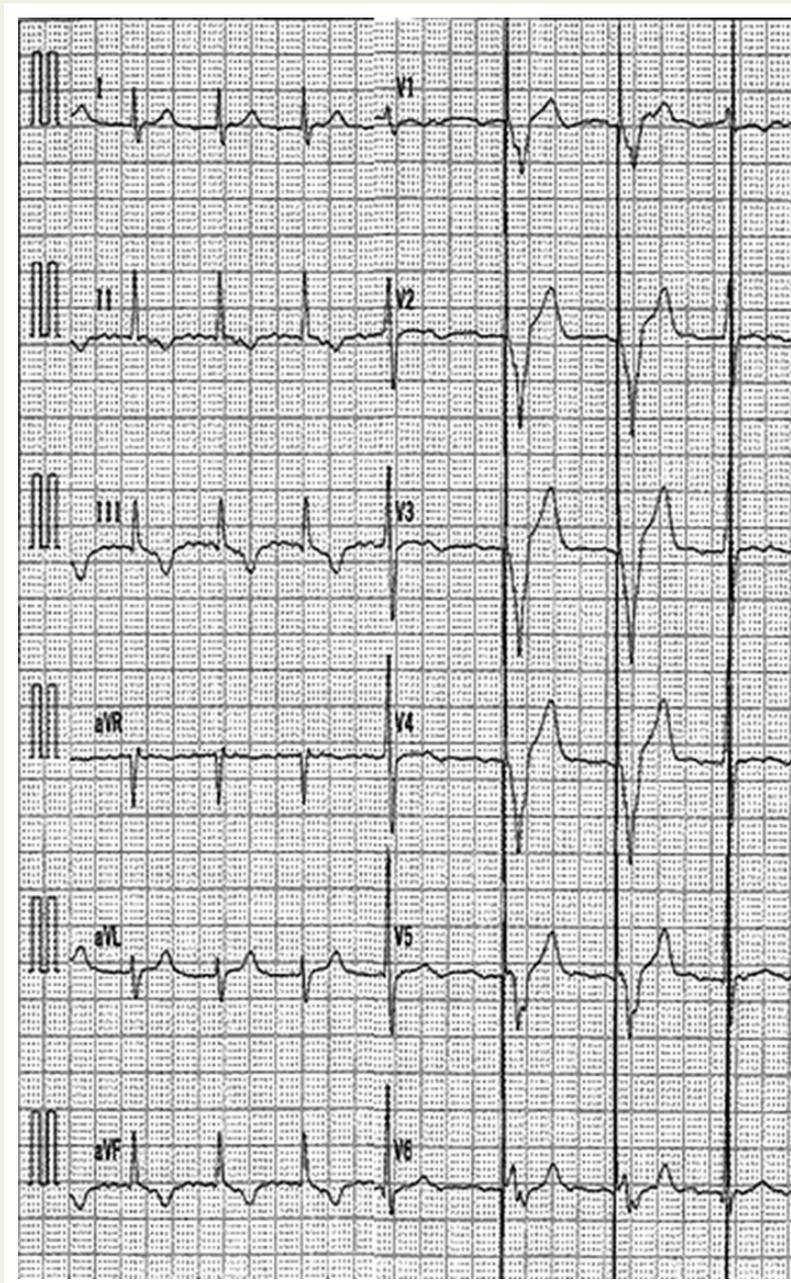
## Abrupt disruption of remote monitoring transmission as an indicator of safe backup mode

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Remote monitoring has been developed for early detection of pacemaker-related problems. A 78-year-old man had a pacemaker that reverted to the safe backup mode; this was identified by the abrupt disruption of remote monitoring because its setting had changed from



**Figure 1** Twelve-lead electrocardiogram at emergent pacemaker clinic with unipolar ventricular pacing in the safe backup mode.

ON into OFF. This case provides evidence that abrupt remote monitoring disruption might indicate a serious pacemaker-related problem.

### Case report

A 78-year-old man with sick sinus syndrome and accompanying persistent atrial fibrillation and atrial tachycardia had undergone dual-chamber pacemaker (Evia DR-T™ Biotronik Inc., Germany) implantation with bipolar screw-in atrial and ventricular leads (Siello JT53™ and Siello S60™, Biotronik Inc.). The operation was uneventful, and the measured pacemaker and lead function values were within acceptable limits. After his discharge, monthly remote interrogation and daily remote monitoring (Home Monitoring™ Biotronik Inc.) was applied in addition to regular check-up visits for his out-of-hospital pacemaker management. Data transmission via remote monitoring had been favourable, and all parameters were consistently normal.

Twenty-two months after pacemaker implantation, data transmission via remote monitoring became disrupted. We called the patient when we saw 'No messages received for 21 days' on Home Monitoring database, and asked him to visit the pacemaker clinic to check his pacemaker status. A 12-lead electrocardiography at an emergency pacemaker clinic indicated unipolar ventricular pacing (Figure 1). On interrogation, pacemaker battery status was OK with remaining battery capacity of 85%. The pacemaker was found to be in the safe backup mode, the remote monitoring setting was switched from ON to OFF, and pacemaker memories had been erased completely. At the approximate time at which the safe backup mode started, the patient was leading an ordinary life with no chance of exposure to causal electromagnetic interference. A thorough inspection of the patient's surroundings failed to identify the cause of the in-circuit excess current. Pacemaker settings were reprogrammed to the former settings. The patient's clinical course was stable for 12 months thereafter.

### Discussion

This case demonstrated two important issues: (i) abrupt disruption of remote monitoring transmission might indicate a change to the safe backup mode and (ii) safe backup could occur even without obvious exposure to electromagnetic waves.

Safe backup may occur when the device is exposed to ionizing radiation, which generates a photoelectric effect and a subsequent causal in-circuit excess current. While a high incidence of safe backup has been reported to occur during magnetic resonance imaging and radiation therapy (3.5 and 10%, respectively),<sup>1,2</sup> the overall incidence of safe backup was relatively lower, at 0.08% in Evia™ (personal communication with Biotronik Japan, Inc.). In these cases, electromagnetic waves and heavy corpuscular rays were the known causes.

On the other hand, there are some safe backup cases, such as the present one, which lack a definitive cause. Because of initiating the safe backup mode, the setting for remote monitoring turns to OFF in Evia. Although remote monitoring has been reported to improve clinical outcomes, its efficacy may depend on the reaction to the remotely monitored transmitted data by medical practitioners.<sup>3</sup> Practitioners should be aware that safe backup can be initiated even during ordinary life away from sources of ionizing radiation, and an abrupt remote monitoring disruption might be the first sign of the start of safe backup mode.

## Acknowledgements

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**Conflict of interest:** none declared.

## References

1. Higgins JV, Sheldon SH, Watson RE Jr, Dalzell C, Acker N, Cha YM *et al.* 'Power-on resets' in cardiac implantable electronic devices during magnetic resonance imaging. *Heart Rhythm* 2015;**12**:540–4.
2. Grant JD, Jensen GL, Tang C, Pollard JM, Kry SF, Krishnan S *et al.* Radiotherapy-induced malfunction in contemporary cardiovascular implantable electronic devices: clinical incidence and predictors. *JAMA Oncol* 2015;**1**:624–32.
3. Slotwiner D, Varma N, Akar JG, Annas G, Beardsall M, Fogel RI *et al.* HRS Expert Consensus Statement on remote interrogation and monitoring for cardiovascular implantable electronic devices. *Heart Rhythm* 2015;**12**:e69–e100.